Eelgrass in Captivity: Population Dynamics in a Confined System

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Abstract

An experimental stockpiling effort was initiated to determine the feasibility of growing eelgrass (*Zostera marina* L.) in flowing seawater tanks. The purpose of stockpiling is to (1) salvage plants that would otherwise be affected by development activities; (2) increase the population while in captivity; and (3) use the stock for restoration, thereby avoiding use of donor stock from undisturbed eelgrass beds. Initiated in the fall of 1997 with approximately 5,500 shoots, the population has stabilized over three growing seasons to the current size of 17,350 shoots. Population dynamics associated with growth in a contained mesocosm have resulted in both decreases and increases in population numbers over time. Initial population decline resulted from dense epiphytic growth on the leaf blades, macroalgae blooms shading the plants, plankton blooms reducing light availability, and mussel colonization on the plants. A population peak was reached in 1999, with nearly 30,000 shoots counted. We hypothesize that the tank has a carrying capacity that was exceeded in 1999, and the population has now stabilized to the current number. Further monitoring will validate this hypothesis and also help determine the effects of natural interannual variability on the population.

Introduction

Eelgrass (*Zostera marina* L.) restoration in the Pacific Northwest generally involves transplanting shoots from a donor area (Thom 1990; Fonseca and others 1998). Concerns associated with this technique include the following:

- Availability of donor stock.
- Introduction of a genetically different strain of eelgrass from a donor area.
- Proximity of the donor area to the restoration site.
- Potential damage to donor bed.

Stockpiling eelgrass is a means of avoiding these problems. Stockpiling involves salvaging plant material from areas of potential known impacts, then maintaining the plants in captivity to enhance rhizome expansion, and propagating new shoots through seed harvesting and planting. Stockpiled plants can then be planted later at a restoration site.

Approximately 3,000 m^2 of eelgrass restoration is planned as part of a mitigation plan for a dock expansion project at the Washington State Ferries terminal at Clinton, Washington. An experimental stockpiling effort was initiated to determine the feasibility of temporarily holding plants that would otherwise be lost due to unavoidable impacts from the expansion activities.

The objectives of this study were as follows:

- Determine the feasibility of maintaining an eelgrass population in captivity.
- Salvage plants that would otherwise be affected by development activities.
- Increase the population while in captivity.
- Use the stock for restoration, thereby avoiding impacts to undisturbed eelgrass beds.

Methods

Approximately 5,500 eelgrass shoots were collected at the Clinton ferry terminal and planted in circular tanks (4.1 m and 9.3 m diameters; Figure 1) at the Battelle Marine Sciences Laboratory in Sequim, Washington, in October 1997. The tanks were filled with clean sand to a depth of 15 cm. The small tank was filled with filtered, flowing seawater and the large tank with non-filtered raw flowing seawater to depths of 1 m. Planting densities were 160 shoots/m^2 in the small tank and 49 shoots/m^2 in the large tank, covering a total area of 81 m^2. In February 1999, the small tank was switched to raw seawater. Shoot counts were conducted annually near the end of the growing season. A sample from the large tank and a sample representative of the clean sand initially placed in the tank were analyzed for total organic carbon in July 2000.

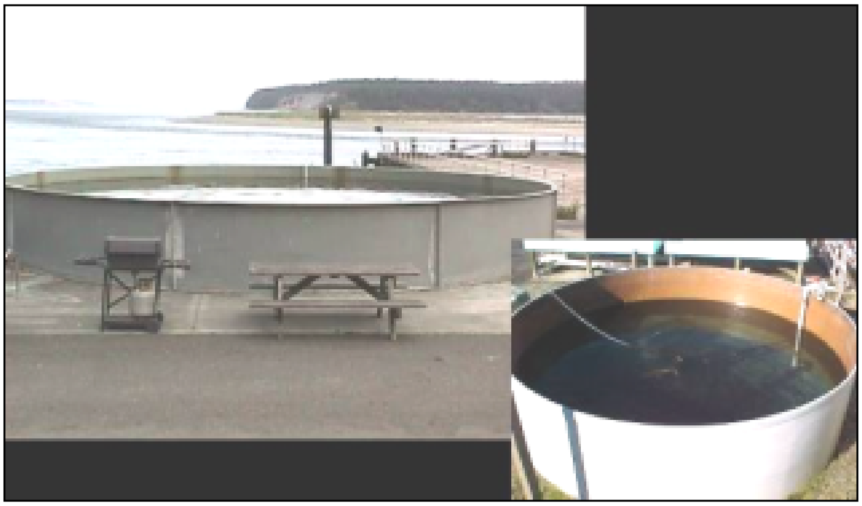

Figure 1. Eelgrass tanks at Battelle Marine Sciences Laboratory.

Results

Large Tank—Raw Seawater

The initial population decline resulted from

- Dense epiphytic growth on the leaf blades.
- Macroalgae blooms shading the plants.
- Plankton blooms reducing light availability.
- Mussel colonization on the plants.

During the first year, grazers and seastars became established and controlled the algae and mussel populations. A population peak was reached in 1999, with nearly 27,000 shoots counted. Many of these shoots were small. We hypothesize that the carrying capacity was exceeded and many of the small shoots did not have enough light to continue development. In 2000, the population of 17,350 shoots generally consisted of larger plants (Figure 2). TOC has increased in the sediment from <1% to 3-5% due to decomposition of vegetative material in the system.

Small Tank—Filtered then Raw Seawater

Epiphytes persisted and the eelgrass eventually began to decline due to the lack of a grazing community. When switched to raw seawater (February 1999), the same algal and mussel population explosions were observed. The eelgrass started to recover in Fall 2000.

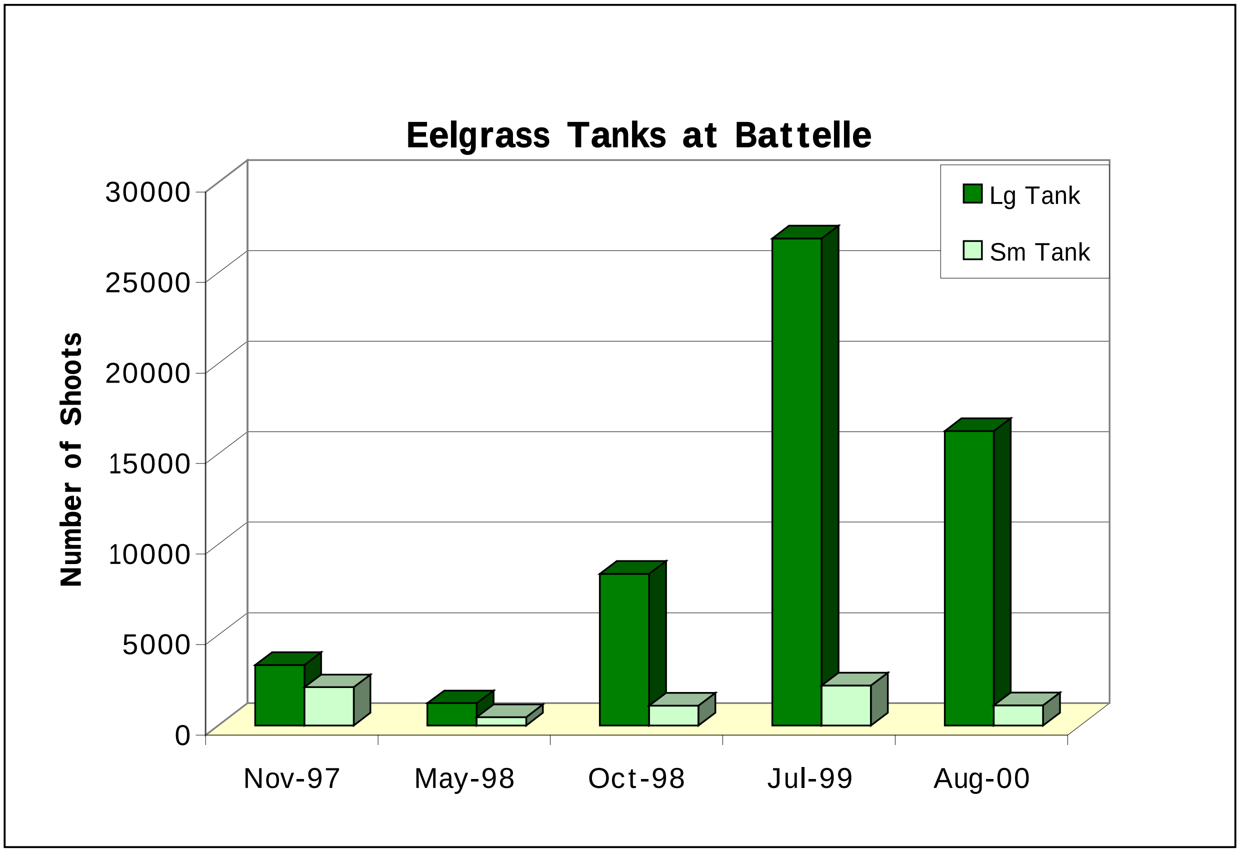

Figure 2. Shoot abundance in the eelgrass tanks from initial planting through August 2000.

Conclusions

Based on the results of this study, we conclude that eelgrass can be successfully propagated. However, critical to the development of healthy eelgrass populations is development of a viable ecosystem. We hypothesize that the development dynamics and population declines we observed under ideal conditions of light and temperature might also be observed in transplanting projects in the field, with an initial decline expected in the first year.

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